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1,923,738

METHOD OF AND MACHINE FOR STRAIGHTENING OR LEVELING STRIP METAL

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Fig. 1.

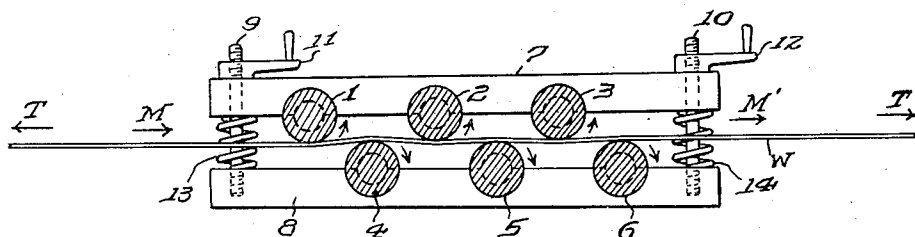


Fig. 2.

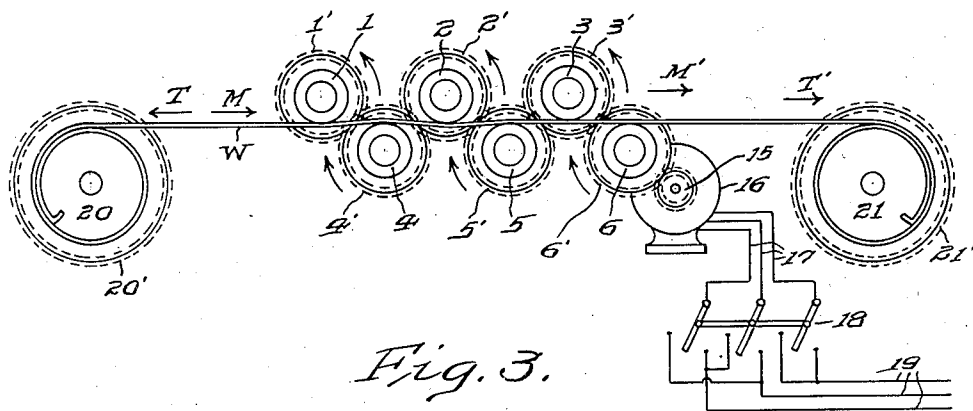
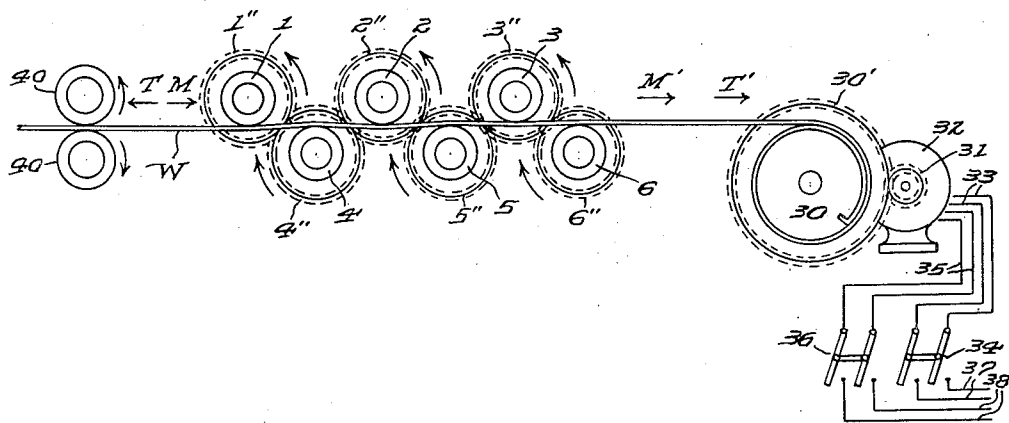


Fig. 3.



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UNITED STATES PATENT OFFICE

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METHOD OF AND MACHINE FOR STRAIGHTENING OR LEVELING STRIP METAL

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3 Claims. (Cl. 153—54)

The present invention relates to the art of straightening and leveling sheet or strip metal, among the objects of the invention being to provide a method by which a better finish may be obtained on the material than by the methods of straightening or leveling heretofore customarily employed; to provide a method by which a flatter strip or sheet may be obtained than has heretofore been possible by the use of said methods, and to provide a method of straightening or leveling continuous strips of metal by which a material saving in labor can be effected.

The invention further includes other objects, advantages and novel steps and operations hereinafter more particularly mentioned or which will be apparent to those skilled in the art from the following description of certain ways of performing the invention in connection with which reference may be had to the accompanying drawing.

Heretofore the straightening or leveling of sheets or strips of metal, more particularly of ferrous, as distinguished from non-ferrous character, has been performed in either of two ways, namely, by subjecting the sheet or strip to tension alone in a stretcher leveler or by successively and progressively bending it over rollers by means of the usual roller leveler. The first of these methods is open to the objection that the strains are frequently distributed unevenly through the metal with the result that strain marks appear therein while, on the other hand, the second is open to the objection that the strip or sheet after subjection thereto frequently will not lie flat or substantially so, although the method is primarily designed to bring about that result.

I have discovered that by simultaneously subjecting the sheet or strip to combined stretching and bending under proper conditions I am enabled to produce an extremely flat sheet devoid of strain marks, which will lie flat or substantially so and which is of better finish than it has been heretofore possible to produce by either of the said methods of leveling or straightening heretofore commonly practised. In the practice of my invention the tensions employed to effect the requisite stretching of the material are preferably extremely high, approaching and in some cases even somewhat exceeding the elastic limit of the material which is being worked but, of course, lying below the ultimate strength of the metal so as to prevent its possible rupture.

To enable those skilled in the art to comprehend and practise the invention I will now describe certain ways of practising the same, and

in connection therewith will refer to the accompanying drawing in which, in Fig. 1, I have diagrammatically shown a strip of metal passing under tension through an apparatus in the nature of a roller leveling machine and designed to impart to the strip the sinuous bending requisite to the performance of the invention. In Fig. 2, I have diagrammatically illustrated another form of apparatus suitable for the performance of the invention showing the strip passing under tension through the same, and in Fig. 3 I have similarly illustrated a still further form of such apparatus with the strip likewise passing there-through. The same characters of reference are employed to designate corresponding parts in the several figures.

In Fig. 1, which is in the nature of a central vertical longitudinal section, the work W consisting of a strip of metal of indefinite length is shown as passing in the direction of the arrows M, M' through an apparatus comprising a plurality of longitudinally spaced upper rolls 1, 2, 3 and a number of longitudinally spaced lower rolls 4, 5, 6 disposed in vertically staggered relation with the upper rolls. The upper rolls are journaled at their ends in a pair of laterally spaced, longitudinally extending housings 7 of suitable form and the lower rolls in a pair of corresponding housings 8 respectively disposed in vertical alignment with the upper housings. Adjacent their extremities the vertically aligned housings are connected by threaded studs 9, 10 respectively carrying bored and threaded cranks 11, 12 above the upper housings by means of which adjustment of the vertical distance between the housings can be effected with corresponding vertical adjustment of the relative position of the rolls respectively carried thereby, heavy springs 13, 14 surrounding the studs being provided for continually pressing the upper and lower housings apart. Thus, by means of the cranks, the height of the upper rolls with respect to the lower rolls can be regulated as desired so as to subject the strip to a greater or less bending action between the rolls as it passes there-through. The rolls may be either positively driven by any suitable means or may simply be rotated by frictional engagement with the strip as it is moved between them.

On the entering side of the rolls a tension T, which for convenience may be termed a negative, retarding, or back tension, is applied to the strip in any suitable way and by any suitable means, this tension operating on the strip in the direction indicated by the arrow, while on the

opposite or exit side of the rolls another tension T', which may be termed a positive or accelerating tension, is applied to the work in any suitable way and by any suitable means to operate thereon in the direction shown by the arrow and thus tending to draw the work through the rolls in the direction M, M'. When the rolls are positively driven and are thus effective in themselves to move the strip in the desired direction, the positive tension T' does not necessarily have to exceed the negative tension T, but when the rolls are undriven it must necessarily exceed that tension to insure the passage of the strip through the rolls. For best results the cranks or other adjusting means employed are so regulated that the vertical distance between the axes of each adjacent pair of upper and lower rolls gradually increases from the entering toward the exit end of the apparatus so that the work is progressively subjected to a progressively decreasing bending action as it passes therethrough. This preferred adjustment of the rolls results when correctly effected in the production of a strip or sheet which will lie flat and devoid of any tendency to curl.

I have indicated the work as passing between the rolls from left to right in the direction of the arrows M, M', but it may with equal facility be passed between the rolls in the opposite direction if desired in which case the adjustment thereof through the medium of the cranks or other adjusting means will preferably be altered so as to bring the rolls 3 and 6 which are now adjacent the entering end of the apparatus slightly closer together than the rolls 1 and 4 which are now on the exit side thereof so as to progressively decrease, for the reasons heretofore mentioned, the amount of bending to which the work is subjected as it passes between the rolls.

It will thus be apparent that in its progress through the machine the work is simultaneously subjected to a high longitudinal tension and to a, preferably decreasing, transverse sinuous bending between the upper and lower sets of rolls whereby the strip is progressively alternately oppositely bent from its normal plane, the extent or amplitude of the transverse deflection of the work from said plane being desirably progressively decreased from the entering to the exit side of the rolls, these combined operations resulting in the production of a substantially flat sheet or strip, devoid of strain marks and of satisfactory finish which, after being taken from the machine has no substantial tendency to curl or otherwise depart from plane or flat condition.

In the apparatus diagrammatically shown in Fig. 2 the roll housings and housing adjusting means by which the vertical distance between the upper and lower sets of rolls respectively designated as 1, 2, 3 and 4, 5, 6 is effected are omitted for the sake of clearness. In this form of apparatus the rolls are positively driven by intermeshing gears 1', 2', 3', 4', 5', 6' which may be either directly mounted on their respective roll shafts or on separate shafts connected to the roll shafts by flexible couplings or in any other suitable way. One of the gears, for example 6', is driven in any convenient way as by a pinion 15 on the shaft of a motor 16 whose leads 17 are desirably carried to a reversing switch or controller 18, in turn connected to the power mains 19, and by means of which the direction of rotation of the motor 16 can be reversed when and as desired.

For supplying the work W to the rolls and

receiving it therefrom, a pair of suitable reels 20, 21 are disposed on opposite sides of the rolls and are preferably arranged to mesh through the gears 20', 21' respectively connected therewith with the pinions of tensioning devices or machines of any suitable form (not shown). Suitable tension devices are disclosed in my U. S. Letters Patent No. 1,881,056, which are capable through the reels of maintaining any desired longitudinal tension in the work W regardless of the direction of its travel.

In Fig. 2 the work is shown as moving between the rolls from left to right as indicated by the arrows M, M', the negative or retarding tension T being impressed thereon at the entrance side of the rolls through suitable operation of the tensioning device interconnected with the reel 20 and a positive or accelerating tension T' being impressed thereon on the exit side of the rolls through similar operation of the tensioning device connected with the reel 21 with the result that, as in the former case, the work as it passes between the rolls is simultaneously subjected to a preferably high degree of longitudinal stretch or tension and to transverse sinuous bending between the rolls which are desirably so adjusted that the amplitude of this bending progressively decreases as the work proceeds between them.

After the work, which may be in the form of a strip of indefinite length, is either completely or substantially completely rolled on the reel 21, it may be desired to again pass it through the rolls in the opposite direction, a result which can be readily accomplished by suitable operation of the reversing switch 18 to reverse the direction of the motor and thereby bring about corresponding reversal in the direction of the travel of the work, the rolls being also preferably readjusted so as to bring the upper and lower rolls on the then returning side more closely together than those on the then exit side.

It will of course be understood that the reels 20, 21 are preferably made of sufficient diameter to avoid imparting a permanent set to the work as it is reeled up upon them so that after removal from the reels it will not be permanently distorted or impressed with any undesirable tendency to curl.

In the apparatus diagrammatically illustrated in Fig. 3, the rolls 1, 2, 3 and 4, 5, 6 are not positively driven but are desirably geared together by the gears 1'', 2'', 3'', 4'', 5'', 6'' so as to prevent them from slipping relatively to each other. A reel 30 is provided for receiving the work as it leaves the rolls and connected, conveniently, through a gear 30', with the pinion 31 of a motor 32 connected through field leads 33 with a field control switch 34 and through armature leads 35 with an armature control switch 36, both switches respectively interconnecting with the power leads 37, 38, the arrangement, or any other suitable one which may be preferred, being such as to provide variable speed control for the motor. The reel 30 through the motor may thus be operated to supply the positive or accelerating tension T' as the work W passes from left to right through the rolls, and for supplying the negative or retarding tension a stand of rolls 40 is provided on the entrance side of the bending rolls. The rolls 40 may either be operated as pinch rolls or, preferably, as reducing rolls in which case a very heavy retarding tension can be imparted to the work, the extent of reduction thereof effected by the reducing rolls being directly reflected in the tension T imparted there-

to. Thus, if an extremely high tension is desired, the rolls may be set to effect a heavy reduction, while for a light tension the rolls will be set to effect a correspondingly smaller reduction.

5 These rolls if desired may be utilized to give the work the last cold roll pass that it receives prior to the straightening and leveling operation with resultant economy in the extent and character of apparatus necessarily provided for the proper performance of the operations incident to the total reduction and subsequent leveling of the work.

As will be apparent from the foregoing, my improved method of straightening and leveling particularly lends itself to use with sheets or strips of indefinite length and when so used thereby effects material economy in production cost as it avoids the necessity of feeding each individual sheet by hand to a roller leveler or stretcher leveler and then removing them by hand from a table on which they are consecutively ejected after passing through the leveler in accordance with the customary practice. Moreover, as hitherto pointed out, the work after being subjected to my improved method of straightening or leveling by means of any of the forms of apparatus to which I have more particularly referred, or by means of other forms of apparatus suitable for the performance of the method, tends to lie perfectly flat, is without undesirable tendency to curl and is devoid or substantially devoid of any strain marks or like imperfections in consequence of which the said method is eminently adapted for use on work in which a high degree of finish is required.

Although I have herein referred to certain forms of apparatus well adapted for the performance of my improved method, I do not there-

by desire or intend to confine myself solely to the use thereof in its performance or, in fact, to the use of any particular form or type of apparatus therefor as any apparatus operatively effective for the carrying out of the method may be employed without departing from the spirit and scope of the invention as defined by the appended claims.

Having thus described my invention, I claim and desire to protect by Letters Patent of the United States:

1. The method of straightening and leveling a metallic strip which consists in holding said strip in tension substantially at the elastic limit between tensioning devices spaced apart, and passing the strip through a circuitous path between said tensioning devices.

2. The methods of straightening and leveling metallic strip which comprises progressively moving the strip longitudinally through a zone located between a retarded uncoiling means and a power-driven coiling means tending to accelerate the motion of said strip, and during said passage bending the sheet from its normal plane first in one direction and then in the opposite direction, while gradually progressively decreasing the amplitude of deflection thereby effected in the sheet.

3. The combination with a rotary reel for receiving a coil of metallic strip, and means for restraining said reel, of staggered rolls for reversely bending said strip when the latter is drawn therefrom, and a power-driven winding-up reel having means adapted to engage the strip and pull it through said rolls from the first mentioned reel.

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50	125
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65	140
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75	150